UT Extension
SP629

Growing Trees from Seed

Often seedlings or saplings for a desired but uncommon tree are not commercially available for planting. Growing trees from seed is an effective method in obtaining these trees. Some people may wish to preserve offspring of a favored parent tree or just enjoy growing trees from seed as a green thumb project. Knowing when and how to collect and germinate tree seed is essential for success.

Seeds are a primary means of trees perpetuating themselves. The proper handling of seed through the processes of ripening or maturation, collecting, processing, storage (if needed), dormancy, stratification and germination is required for success in producing a new seedling. Most tree species are unique in their requirements for seed germination. Seed maturation, handling, storage, dormancy, stratification and germination are different for many species. This publication gives a short overview of these processes and lists the germination requirements for particular woody species or groups of species.

Red maple samaras are dispersed in the spring, one of the few species with spring dispersal of seed.

Seed Maturation

Seed should be collected as soon as they mature. A few days' delay in collection sometimes makes a difference between collection success and failure. Seed of some species disperse quickly in the wind or are highly attractive for consumption by birds and mammals. Monitoring seeds as they ripen and mature and collecting them before or as they disperse will improve seed collection.

For most species, seed maturity is subjectively judged by visual indicators such as color, firmness of fleshy fruit, drying and opening of cone scales, size and differences in texture and moisture content. Most seed are mature and disperse at the end of the growing season during the fall

Southern magnolia seed dispersing from its conelike fruit.

and early winter months after flowering in the spring. A few exceptions to seed dispersal in the fall are red and silver maple, most elms and river birch. The seed of these species mature and are dispersed in the spring and early summer. Changing color is usually a good indication of maturity. Seed color becomes duller, often turning light to dark brown as moisture content of the seed declines. Ripeness or texture (softening) of fleshy fruits is another indicator of maturity.

Seed Processing

Most seed contain some type of physical structures that must be removed before seeds are stored or planted. Seeds must be extracted from the pine, spruce, hemlock or fir cones; yellow-poplar, pine and maple seeds are usually dewinged; husks are removed from hickory and walnut seeds; fleshy fruits are usually softened, chopped and rinsed with water (macerated) to obtain the seed; and legume pods (black locust, honeylocust, redbud, yellowwood) are broken to remove the seed.

Fleshy fruits such as berries (persimmon and mulberry), drupes or stone fruits (dogwood, magnolia and cherry) and pomes (crabapple, pear and hawthorn) are some of the most difficult seeds to extract. Processing usually involves macerating the flesh, separating the seeds through the abundant use of water and different sizes of screens, and then drying. Processing should begin as soon as seed are collected. Seed can be damaged if the fruits begin to ferment.

Pre-Storage Care

The seeds of most woody species can be classified into three groups for pre-storage care: (1) seeds that must be dried for extraction and storage (sweetgum, sycamore, yellow-poplar, ash, red maple), (2) seeds that must be kept moist for storage (recalcitrant seeds such as oak and buckeye) and (3) seeds that must be kept moist for extraction, then dried for storage (seeds with fleshy fruits such as holly, dogwood, plum and eastern redcedar) (Bonner, 1992). A fourth group of seeds can either be stored overwinter under moist conditions or planted in the fall directly after seed collection (hickories, white oak, walnut).

Most seeds should be stored overwinter at low moisture content (5 to 10 percent) and at cool temperatures (34 to 40 degrees F). However, the recalcitrant group can only be stored at high moisture contents. Once dried, they cannot be rehydrated, or they will not germinate. Likewise, if seeds with high moisture contents are frozen, the ice crystals disrupt the cellular tissue of the seed, causing it to die. Thus, recalcitrant seeds are stored best at high moisture contents and temperatures just above freezing (>32 degrees F) in polyethylene bags of about 4 mils wall thickness. Thinner bags allow water vapor loss, which dries the seeds. Thicker bags inhibit gas exchange needed for respiration. Seeds should be kept moist, but not in standing water within the bag. Household refrigerators often have dehumidifiers that draw moisture from the seeds. Check bags periodically during storage and add water to the bag, if needed. Recalcitrant seeds can only be stored overwinter without sacrificing viability, while seeds at lower moisture contents can be stored for several years at low moisture contents and below-freezing temperatures.

Controlling moisture and temperature are essential in storage of seed. The rule-of thumb is if temperature in degrees F plus relative humidity in percent equals less than 100, then conditions are satisfactory for storage from fall extraction and cleaning until sowing in the spring. If long-term storage is necessary, then good cold-storage equipment is essential. Most large refrigeration systems have high humidities where seed may actually gain moisture. Thus, dried seeds should be kept in moisture-proof containers to prevent uptake of moisture from the atmosphere. Seeds kept at 5 to 10 percent moisture at subfreezing temperatures can be stored for many years.

Dormancy

Some seeds exhibit dormancy, defined as the inability for seed to germinate under favorable conditions, which must be addressed before the seed can germinate. There are three types of dormancy: internal, physical and a combination of internal and physical. ***Internal dormancy*** is associated with the failure of certain physiological processes to occur inside the seed. These seed should be stratified (see glossary for definition) in moist, cool (above freezing) conditions for a certain amount of time (varies by species, see attached table) to motivate internal processes to relieve this dormancy. Red oak, sugar maple and pines are examples of seed that exhibit internal dormancy.

With ***physical dormancy***, the seed has some morphological condition, such as impermeability to moisture or gases or mechanical restrictions, which does not allow the seed to germinate. Usually scarifying or scratching the seedcoat to allow the seed to imbibe moisture suspends physical dormancy. Scarification could be by mechanical abrasion or by chemicals that break down or dissolve the seedcoat. Seeds eaten by wildlife are often scarified within their digestive system and then deposited. Most legumes have physical dormancy.

Seeds that exhibit ***combined internal and physical dormancy*** must be stratified as well as scarified. Dogwood, holly and cherry are common examples of species with combined dormancy.

Germination

Once dormancy is alleviated, seeds are ready to germinate. Germination is probably the most critical stage during the life of a tree. If the tender germinant does not have the favorable moisture, temperature, soil and light conditions for further growth, the germinating seed dies. Less than 1 percent of all germinating seed survives to become a seedling in natural conditions. Excessively wet or excessively dry conditions, too much or not enough direct sunlight or too hot or too cold daily temperatures doom many germinating seeds.

With the overwinter storage of seed, conditions are simulated that the seed would encounter naturally. When seeds are dispersed in the fall, moisture content of the soil is low. The seed remains in a resting state (caused by dormancy) because the fall/winter ground environment is at low moisture and low temperatures. Rains during the spring increase the amount of soil moisture, allowing the seed to absorb moisture, thereby initiating a natural stratification. Once temperatures increase in late spring, conditions are fortuitous for seed germination.

Most seed naturally succumb due to fluctuating weather conditions during the winter and early spring. Usually only a few seed become seedlings. When seed are collected, stored, stratified or scarified and planted in the spring under more controlled conditions, more consistent germination and survival are achieved. Seeds can be planted in the fall, but with less consistency in survival.

Either fall sowing with untreated seed or spring sowing with stratified seed is used for hickories, walnut and white oak. Mulching and protection from rodents are necessary for fall sowing. Protection from rodents can be achieved by placing chicken wire over the soil that covers the seed. These seeds must maintain high moisture contents during the winter for germination in the spring. Storage of seed in polyethylene bags in cool (above freezing), moist conditions is recommended before spring planting.

Different species of tree seed germinate optimally under different light and temperature conditions. Some species prefer diurnal (fluctuating day and night) temperatures; some prefer the same temperature. Others germinate best in full light, no light or in sequences of light and dark. Refer to the *Seeds of Woody Plants in the United States,* USDA Agriculture Handbook 450 (1974) for these germination recommendations by species. Information about the collection and storage requirements of seed of many common tree species in Tennessee is given in the accompanying table.

Seed should be germinated in flats or pots and transferred to the field once germinants are large enough for transplanting. Seed also can be planted and germinated in the field. However, the environmental conditions are again less controlled and seed are more subject to external influences. When planting seed under field conditions, always plant more seed than needed to compensate for variability in germination and survival. Also plant a few seed in more controlled conditions so you can ascertain whether irregularities in germination are site- or weather-related or seed-related. Planting sites should have the soil prepared for growth of the new germinant. Other plants (herbaceous or woody competition) should be controlled.

Summary

Growing trees from seed can be a fulfilling experience if particular attention is given to the collection, processing, storage and germination requirements of seed. Scarification and/or stratification are required to alleviate seed dormancy. Seeds are living organisms and must be treated in the correct manner to ensure their germination and subsequent growth. The germination requirements of seed often vary by tree species. Thus, one must be familiar with the seed requirements of each species to be successful when growing trees from seed.

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Type of Dormancy, Storage Conditions and Stratification Periods of Seed of Common Woody Species in Tennessee (Schopmeyer 1974).

Botanical Genus	Common Name	Type of Seed	Type of Dormancy	Storage Conditions	Cold Stratification Period
Abies spp.	firs	Cone	Internal	Cool, Dry	30 days
Acer rubrum	red maple	Samara	None	Cool, Dry	None
Acer saccharinum	silver maple	Samara	None	Cool, Moist	None
Acer saccharum	sugar maple	Samara	Internal	Cool, Dry	30 to 90 days
Aesculus spp.	buckeye	Capsule	Internal	Cool, Moist	120 days
Albizia spp.	mimosa	Legume	Physical	Cool, Dry	None
Alnus spp.	alder	Nut	Internal	Cool, Dry	30 to 60 days
Amelanchier spp.	serviceberry	Pome	Internal	Cool, Dry	60 to 120 days
Asimina spp.	pawpaw	Berry	Internal	Cool, Dry	60 days
Betula spp.	birch	Winged nut	None	Cool, Dry	None
Carpinus spp.	hornbeam	Nutlet	Internal	Cool, Dry	60 days
Carya spp.	hickory	Nut	Internal	Cool, Moist	30 to 150 days
Castanea spp.	chestnut	Nut	Internal	Cool, Moist	60 to 90 days
Celtis spp.	sugarberry	Drupe	Internal	Cool, Dry	60 to 90 days
Cercis spp.	redbud	Legume	Combined	Cool, Dry	30 to 60 days
Chionanthus spp.	fringetree	Drupe	Combined	Cool, Dry	60 days
Cladrastis spp.	yellowwood	Legume	Combined	Cool, Dry	30 days
Cornus spp.	dogwood	Drupe	Combined	Cool, Dry	120 days
Corylus spp.	American hazel	Nut	Internal	Cool, Moist	90 to 120 days
Cotinus spp.	smoketree	Drupe	Combined	Cool, Dry	60 days
Crataegus spp.	hawthorn	Pome	Internal	Cool, Dry	120 days
Diospyros spp.	persimmon	Berry	Internal	Cool, Dry	60 to 90 days
Fagus spp.	beech	Nut	Internal	Cool, Moist	90 days
Fraxinus spp.	green & white ash	Samara	Internal	Cool, Dry	60 to 90 days
Gleditsia spp.	honeylocust	Legume	Physical	Cool, Dry	None
Gymnocladus spp.	KY coffeetree	Legume	Physical	Cool, Dry	None
Halesia spp.	silverbell	Drupe	Internal	Cool, Dry	60 to 120 days
Ilex spp.	holly	Drupe	Combined	Cool, Dry	60 to 120 days
Juglans spp.	walnut	Nut	Internal	Cool, Moist	90 to 120 days
Juniperus spp.	juniper	Berry	Internal	Cool, Dry	30 to 120 days
Koelreuteria spp.	golden raintree	Capsules	Physical	Cool, Dry	60 days
Liquidambar spp.	sweetgum	Ball-like capsule	Shallow Internal	Cool, Dry	15 to 30 days
Liriodendron spp.	yellow-poplar	Cone	Internal	Cool, Dry	60 to 90 days
Magnolia spp.	magnolia	Drupelike	Internal	Cool, Dry	90 to 120 days
Malus spp.	crabapple	Pome	Internal	Cool, Dry	60 to 120 days
Morus spp.	mulberry	Berry	Internal	Cool, Dry	30 to 90 days
Nyssa spp.	blackgum	Drupe	Internal	Cool, Dry	30 to 60 days
Ostrya spp.	hophornbeam	Nut	Internal	Cool, Dry	60 to 90 days
Oxydendrum spp.	sourwood	Capsule	None	Cool, Dry	None
Picea spp.	spruce	Cone	None	Cool, Dry	None

Type of Dormancy, Storage Conditions and Stratification Periods of Seed of Common Woody Species in Tennessee (Schopmeyer 1974).

Botanical Genus	Common Name	Type of Seed	Type of Dormancy	Storage Conditions	Cold Stratification Period
Pinus spp.	pines	Cone	Internal	Cool, Dry	30 to 60 days
Platanus spp.	sycamore	Globular head	None	Cool, Dry	None
Prunus spp.	black cherry	Drupe	Internal	Cool, Dry	120 days
Quercus spp.	red oaks	Nut/acorn	Internal	Cool, Moist	60 to 90 days
Quercus spp.	white oaks	Nut/acorn	None	Cool, Moist	None
Robinia spp.	black locust	Legume	Physical	Cool, Dry	None
Sassafras spp.	sassafras	Drupe	Internal	Cool, Dry	120 days
Sorbus spp.	mountain-ash	Pome	Internal	Cool, Dry	60 days
Taxodium spp.	baldcypress	Globus cones	Internal	Cool, Dry	90 days
Tilia spp.	linden	Capsules	Combined	Cool, Dry	90 days
Tsuga spp.	hemlock	Cones	Internal	Cool, Dry	30-120 days
Ulmus spp.	elm	Samara	None	Cool, Dry	None

Glossary (*adapted from* Bonner, 1984)

Dormancy. A physiological state in which a seed predisposed to germinate does not, even in the presence of favorable environmental conditions.

Dormancy, Combined. Dormancy as a result of two or more primary factors, such as seedcoat dormancy and embryo dormancy.

Dormancy, Internal. Dormancy as a result of condition within the embryo: inhibiting substance, cotyledon influences, impermeable structures.

Dormancy, Physical. Dormancy as a result of seedcoat conditions: impermeability to gases or moisture or mechanical restrictions.

Embryo. The rudimentary plant within the seed.

Germination. Resumption of active growth in an embryo which results in its emergence from the seed and development of those structures essential to plant development.

Maturity. A general term for the stage in the life cycle of a seed when development is complete and the biochemical components necessary for all physiological processes are active or ready to be activated.

Scarification. Disruption of seed coats, usually by mechanical abrasion or by brief chemical treatment in a strong acid, to increase their permeability to water and gases, or to lower their mechanical resistance.

Stratification. Practice of placing seeds in a moist medium to overcome dormancy. Commonly applied to any techniques that keep seeds in a cool and moist environment.

White fruit on Tatarian dogwood. Dogwood seed has both internal and physical dormancy, requiring both stratification and scarification.

Assortment of acorns from different red oak species (*Quercus* spp.)

Germinating Kentucky coffeetree seed. Germinating seed is quite vulnerable to adverse weather and soil conditions.

Open cones of Canadian hemlock.

Fruits of hollies (*Ilex* spp.) are soft mast cherished by birds and small animals.

Recommendations

1. Collect mature seed.
2. Process and clean seed (if needed) within a week after collection.
3. Store normal seed at dry moisture contents at temperatures near or below freezing.
4. Store recalcitrant seeds at high moisture contents and temperatures above freezing.
5. Determine dormancy requirements of species.
6. Stratify and/or scarify seed (if needed) to solve dormancy requirements.
7. Plant seed in spring (or fall when recommended) and monitor seed germination, survival and growth.
8. Plant a few seed in more controlled environmental conditions to evaluate differences in seed germination and growth with field-planted seeds.

All photos by Wayne Clatterbuck

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